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Status of Atlantic salmon in the Restigouche River, 1984

by

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ABSTRACT

Severe controls on the harvest of large salmon in the Restigouche River in 1984 restricted homewater landings to 2,773 salmon, compared to 7,659 fish in 1983. Despite similar returns of large salmon in 1983 and 1984, a greater proportion potentially survived to spawning in 1984 (74% versus 38% in 1983) because of this reduced homewater harvest. Spawning escapement was estimated to be 42 to 114% of requirements. Grilse catches in 1984 were higher than in 1983 (7,983 versus 2,332) suggesting returns of grilse were greater. Large salmon returns in 1985 were forecasted to be about 12,000 fish; therefore, spawning requirements will only be met if there are no homewater removals. If returns of grilse in 1985 are average, there could be a surplus of 6,000 grilse.

RÉSUMÉ

Les prises de saumons rédibermarins dans la Rivière Restigouche en 1984 furent limitées à 2 773 poissons, grâce à l'imposition de restrictions sévères sur la pêche. En 1983 ces prises se chiffraient à 7 659 poissons. Quoique les retours de saumons rédibermarins furent semblables pour 1983 et 1984, le potentiel de survie jusqu'au frai fut augmenté considérablement en 1984 (74% contre 38% en 1983) grâce à cette baisse dans les prises. Le nombre estimatif de géniteurs ayant échappé à la pêche se situe entre 42% et 114% des besoins calculés. Les prises de madeleineaux en 1984 furent supérieures à celles de 1983 (7 983 contre 2 332 en 1983), ce qui suggère une augmentation dans les retours. Les prévisions des retours de saumons rédibermarins pour 1985 se chiffrent à environ 12 000. Les besoins en géniteurs seront donc atteints seulement si il n'y a aucune pêche dans les eaux natales. Si les retours de madeleineaux sont normaux en 1985, il pourrait y avoir un surplus d'environ 6 000 madeleineaux.

INTRODUCTION

Regulations controlling the harvest of salmon from the Restigouche River in 1984 were more severe than in 1983. Commercial fishermen on the New Brunswick side of Baie des Chaleurs were restricted to a two-week season (July 9-20) with no quota, rather than a seven-week season (June 13 - July 31) and a quota of 4,000 salmon and 4,000 grilse as in 1983. There was no commercial fishery allowed on the Quebec shore of Baie des Chaleurs in 1984. New Brunswick anglers were restricted to a grilse only fishery (salmon < 63 cm); large salmon were released. Quebec anglers were allowed to keep both grilse and salmon, but their daily and seasonal bag limits were reduced by 50% from 1983 (to 1 and 7 fish, respectively). Native fishermen at Cross Point were allocated a reduced quota of 6,995 kg, compared to 16,648 kg in 1983. Native fishermen at Eel River Bar, as in 1983, were not restricted by quota.

Salmon from the Restigouche River are also intercepted in the Newfoundland and commercial fishery each year (Pippy 1982). Reduced seasons and closures in many areas of Newfoundland during 1984 should have reduced these interceptions.

The objective of this assessment was to (i) summarize 1984 landings, (ii) estimate current spawning escapement and (iii) evaluate the impact of the 1984 management plan on the salmon stock from the Restigouche River.

METHODS

a. Landings

Commercial salmon fishermen from Baie des Chaleurs reported landings on a weekly basis to DFO. Landings were divided by size into grilse (<63 cm), small salmon (63-85 cm) and large salmon (>85 cm). Effort was calculated as total fishing days (season (d) X fishermen).

Angling catches from the Matapedia, Patapedia, Kedgwick and Main Restigouche Rivers were reported by the Ministère du Loisir, de la Chasse et de la Pêche (MLCP). New Brunswick angling catches were summarized monthly by DFO officers. Crown open and crown reserve angling data were provided by the New Brunswick Department of Natural Resources (DNR). Effort from all three sources was given in rod days, where 1 rod day was defined as 1 fishermen fishing a river for any portion of one day.

Native fishery landings from Cross Point, Quebec, were provided by MLCP. Landings from Eel River Bar, NB, were reported weekly to DFO by the Band Council Office.

Counts of salmon and grilse at a fish barrier in the upper Upsalquitch River were available from DNR. This fish barrier has been operated since 1980.

Biological characteristics and ages of spawning salmon were determined from about 200 fish sampled from the commercial and Native fisheries. Sampling included: recording gear, area and date; removing scales for aging; recording length (cm) and weight (0.1 kg).

b. Stock and recruitment

Juvenile salmon densities were estimated at 50 sites in the Restigouche River during 1984. Chadwick and Randall (1983) used historical juvenile densities (1972 to 1980) as an estimate of recruitment for calculating a stock-recruitment relationship. This relationship was updated for this assessment using current (1983 and 1984) parr densities. Angling catches of large salmon (New Brunswick) were used as an estimate of spawning stock.

c. Egg deposition requirements

Methodology used for calculating spawning requirements for the Restigouche River was described by Randall (1984).

d. Spawning escapement in 1984

As in the previous two assessments (Chadwick and Randall 1983; Randall and Pickard 1983), two methods were used to calculate spawning escapement in 1984:

Method 1: An angling exploitation rate of 0.20 was used. This rate was calculated by Chadwick and Randall (1983) using tagging information for Restigouche salmon from 1972 and 1973. Escapement was estimated as angling catch / 0.20, minus angling and poaching removals. Total returns were calculated as the sum of escapement, harvest and poaching removals.

Method 2: A ratio of spawner to angled fish of 0.72 was used (Table 1). Total egg deposition (1972 to 1982) was back-calculated from small parr densities assuming 10% survival (Elson 1957, 1974; Chadwick 1982), and a rearing area of 29,768,000 m^2. Spawners were calculated from egg deposition by dividing by eggs per salmon (Randall 1984) and were proportioned into salmon and grilse spawners using proportions of salmon from angling catches (Table 2). Escapement in 1984 was estimated as the product of the spawner to angled fish ratio and angling catch in 1984.

For both methods, mortalities of salmon due to poaching and disease were assumed to be 2,000 salmon and 1,000 grilse. Recorded furunculosis mortalities were 200 salmon and 50 grilse (A. Madden, DNR, Campbellton); however, poaching or unaccounted losses in freshwater were probably much higher, as discussed later.

Since New Brunswick anglers were not allowed to land large salmon in 1984, a hypothetical angling catch was estimated from (i) a correlation between Quebec angling and New Brunswick angling landings, 1970 to 1983, and (ii) a correlation between catch and release of salmon at four angling camps and total Restigouche catches, 1970 to 1983 (Chadwick et al. 1984).

e. Forecast of 1985 returns of large salmon

Returns of large salmon to the Restigouche River in 1985 were predicted from a significant correlation between grilse at Kedgwick Lodge (year i) and total Restigouche salmon returns (year i +1). Data from Kedgwick Lodge are given by Chadwick et al. (1984).

RESULTS

a. 1984 Landings

Total Baie des Chaleurs commercial landings in 1984 were 2,026 salmon and 7,161 grilse (Table 3). Effort was substantially lower in 1984 than in 1983; fishing days (number of traps X number of fishermen) were reduced from 836 to 220. This reduction was primarily because of the shorter season (July 9-20), but also fewer fishermen operated in 1984 (20) than in 1983 (25). Despite less effort, however, landings of grilse were up considerably (387%) and salmon catches were comparable to 1983. It was difficult to interpret whether or not this indicated increased returns, however, since there was no quota in 1984.

Tagging studies in 1983 indicated some of the salmon landed in Statistical Districts 64 and 65 were destined for the Nepisiguit River (Lutzac 1984). Landings in 1984 were adjusted using these same proportions, and all remaining fish were assumed to be of Restigouche River origin (Table 3).

The New Brunswick angling season in 1984 was the same as in 1983 (June 15 to August 31) while the Quebec season was delayed by two weeks (June 15 until August 31). Angling landings were 590 salmon and 1,990 grilse (Table 4). In Quebec, since total effort was similar in 1984 to 1983 (6,915 rod days compared to 6,664), increased grilse catches in 1984 (612 compared to 181) suggest increased returns. Grilse catches were also up in New Brunswick (1,378 from 715), but at least part of this increase resulted from all angling effort being directed towards grilse. Large salmon catches in Quebec were down slightly in 1984 (590 compared to 587 in 1983), suggesting approximately equal returns in both years.

Native fishermen at Cross Point reported landing 1,081 salmon and 173 grilse; thus they attained their quota. Native fishermen at Eel River Bar reported a catch of 213 salmon.

Total Restigouche landings in 1984 were 2,773 salmon and 7,983 grilse (Table 5). These landings are compared to historical catches in Table 6.

Counts of both salmon and grilse in the Upsalquitch River were up in 1984 compared to 1983 (Table 7). However, grilse returns were below the 1980-82 average, while salmon returns were average.

Samples of fish examined from commercial and Native fisheries indicated salmon and grilse were predominately from the 1979 and 1980 year-classes, respectively. Biological characteristics of salmon are given below:

Sea age (yr)	n	Fork length (cm)	Weight (kg)	Condition
1SW	72	52.7	1.41	0.95
2SW	103	75.7	4.51	1.03
3SW	23	91.0	8.58	1.13
Multiple spawner	11	101.5	12.36	1.16

b. Stock and recruitment

Densities of fry, small parr and large parr were down slightly in 1984 from 1983 (Table 8). A stock-recruitment relationship for Restigouche salmon, using these data, is illustrated in Figure 1. Small parr (recruitment) were significantly correlated to angled salmon (spawning stock) as described by the equation: $y = 1.91 + 0.0012\ x$ ($r = 0.75$, $P < 0.01$), where y = parr (year i +2) and x = angled salmon (year i).

c. Spawning requirements

Egg deposition requirements for the Restigouche River were calculated to be 71,443,200 eggs (Randall 1984). About 12,200 salmon are required to achieve this deposition; another 2,600 grilse are required to ensure a 1:1 sex ratio at spawning.

d. Spawning escapement in 1984

The two estimates of total angling catch of large salmon in the Restigouche River for 1984 (Quebec catch plus hypothetical NB landings) were not significantly different:

Method	R^2	Predicted catch of large salmon	Adjusted total catch
1) Quebec versus NB angling	0.52	1,937 (0 - 4,401)	2,527
2) NB camps versus total angling (Chadwick et al. 1984)	0.88	2,837 (1,895 - 4,759)	3,327

Both estimates had inherent biases. Quebec angling slightly underestimated total Restigouche angling since effort in 1984 was less than in previous years (bag limits). On the other hand, total angling estimated from camp data (Chadwick et al. 1984) was an overestimate; the 1984 prediction was based on catch and release data which, since no salmon were landed, was probably inflated because of recaptures. However, the latter estimate (3,300) was used since the correlation was better.

Spawning escapements as estimated by Methods 1 and 2 were substantially different:

	Method 1		Method 2	
	Salmon	Grilse	Salmon	Grilse
1. Total returns	18,683	15,943	9,893	10,416
2. Harvest	2,773	7,983	2,773	7,983
3. Poaching and disease	2,000	1,000	2,000	1,000
4. Broodstock	34	0	34	0
5. Spawning escapement	13,876	6,960	5,086	1,433
6. Target spawners	12,200	2,600	12,200	2,600
% of target achieved	114%	268%	42%	55%

Escapement estimated from the angling exploitation rate indicated spawning requirements were met, while escapement estimated from the ratio of spawners to angled fish indicated salmon and grilse spawners were below requirements by 58 and 45%, respectively. In terms of egg deposition, Method 2 indicated a spawning deposition of 30.2 X 10^6 eggs (42% of requirements).

e. Prediction of 1985 returns

Total large salmon returns to the Restigouche River in 1985 were predicted from the equation (Table 9):

$$y = 6842.1 + 64.8\ x\ (r = 0.76,\ P < 0.01)$$

where y = salmon returns (year i +1)
x = grilse catch at Kedgwick Lodge (year i)

The 1985 predicted return of salmon was 12,219 (6,195 - 18,243).

Grilse returns, assuming average returns from 1982 to 1984, could be about 9,000 fish. Grilse in 1985 will be predominantly from the 1981 year-class; fry and parr densities of this year-class were average (Table 8).

DISCUSSION

Angling landings (Quebec) and catch and release data (New Brunswick) indicate large salmon returns to the Restigouche River in 1984 were similar to 1983. Predicted returns (from Randall and Pickard 1983) are compared to actual returns below:

	Method 1	Method 2
Predicted returns	16,000	11,300
Actual	18,700	9,900
% difference	+17	-12

Both methods were reasonably accurate in estimating salmon returns in 1984. Actual total returns (10,000 - 20,000 salmon) were comparable to estimated returns in 1982 and 1983 (Chadwick and Randall 1983; Randall and Pickard 1983), indicating Restigouche stocks have remained low.

Greater restrictions on the harvest of Restigouche salmon in homewaters during 1984, however, increased the survival of returned salmon to spawning. Potential spawning escapement from 1982 to 1984 is compared to total returns below:

	1984	1983	1982
Total returns	18,700	15,700	24,200
Potential spawners	13,900	5,900	12,600
% survival	74%	38%	52%

Survival of homewater returns to spawning thus increased from 38% in 1983 to 74% in 1984, primarily because of reduced harvests. Most egg deposition (greater than 95%) in the Restigouche River comes from large salmon (Randall 1984). Spawning escapement of large salmon as calculated using Methods 1 and 2 indicated between 42 and 114% of spawning requirements were achieved in 1984.

The large discrepancy observed between estimates of egg deposition result from the fact that Method 1 estimates potential spawners (from angling catches) while Method 2 estimates actual spawners (from parr densities). Differences between potential and actual egg depositions from 1972 to 1982 were considerable (average 82%; Table 11). These differences could result from:

(i) the use of an angling exploitation rate that was much too low;
(ii) greater mortalities after angling and before spawning (from disease and poaching) than we presently assume.

Probably both factors contribute to the discrepancy, but whatever the reason, these results indicate spawning escapement as estimated by Method 1 was much too high.

The stock-recruitment relationship for the Restigouche River (Figure 1) verified that spawning levels have been low in recent years. The relationship was linear and not asymptotic, indicating that carrying capacity for juveniles had not been achieved.

Because estimates using Method 1 were too optimistic, escapement and total returns for forecasting were calculated using Method 2 (Table 10). Grilse catches at Kedgwick Lodge in 1984 predict a total return of large salmon of about 12,200 fish in 1985. Thus, spawning requirements could be met, but only if there is no homewater fishing mortality and if unaccounted losses in freshwater (i.e. poaching) are reduced.

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Table 1. Ratios of spawner per angled fish in the Restigouche River, 1972 to 1982.

Year (i)	Parr (i+2)	Eggs/ Salmon	Proportion salmon	Spawners		Ratio of spawner per angled fish
				Salmon	Grilse	
1972	0.071	5,661	0.82	3,733	820	0.74
1973	0.097	6,282	0.76	4,596	1,452	0.94
1974	0.084	6,056	0.84	4,129	786	0.69
1975	0.044	6,565	0.69	1,995	896	0.69
1976	0.083	6,441	0.67	3,836	1,889	0.70
1977	0.071	5,445	0.71	3,882	1,585	0.58
1978	0.041	6,094	0.76	2,003	632	0.40
1979	0.036	6,155	0.42	1,741	2,404	0.96
1980	0.044	4,700	0.66	2,787	1,435	0.45
1981	0.069	5,933	0.54	3,462	2,949	0.82
1982	0.050	5,933	0.48	2,509	2,717	0.97
Mean						0.72
S.D.						0.19

Table 2. Angling catches in the Restigouche River, 1970 to 1984.

Year	Salmon			Grilse			Proportion salmon
	PQ	NB	Total	PQ	NB	Total	
1970	326	1,716	2,042	166	1,340	1,506	0.58
1971	259	757	1,016	173	999	1,172	0.46
1972	1,171	3,870	5,041	111	978	1,089	0.82
1973	1,146	3,740	4,886	147	1,423	1,570	0.76
1974	1,163	4,785	5,948	129	1,038	1,167	0.84
1975	741	2,160	2,901	149	1,130	1,279	0.69
1976	1,029	4,481	5,510	377	2,345	2,722	0.67
1977	1,579	5,128	6,707	459	2,333	2,792	0.71
1978	1,652	3,373	5,025	282	1,322	1,604	0.76
1979	826	997	1,823	556	1,990	2,546	0.42
1980	2,059	4,098	6,157	409	2,833	3,242	0.66
1981	1,408	2,832	4,240	635	3,010	3,645	0.54
1982	962	1,620	2,582	402	2,449	2,851	0.48
1983	587	1,481	2,068	181	715	896	0.70
1984	590	0	590	612	1,378	1,990	0.23

Table 3. Baie des Chaleurs commercial landings, 1983 and 1984. Proportion of fish destined for Nepisiguit River is given (Lutzac 1984); the remainder are assumed to be Restigouche salmon.

	District	Effort (d)	Total landings		Proportion Nepisiguit		Restigouche landings	
			Salmon	Grilse	Salmon	Grilse	Salmon	Grilse
1983								
	63	620	1,488	628	0	0	1,488	628
	64	92	275	141	0.35	0.02	179	138
	65	124	462	700	0.77	0.21	106	553
	TOTAL	836	2,225	1,469			1,773	1,319
1984								
	63	143	415	510	0	0	415	510
	64	22	246	290	0.35	0.02	160	284
	65	55	1,365	6,361	0.77	0.21	314	5,025
	TOTAL	220	2,026	7,161			889	5,819

Table 4. Angling statistics for the Restigouche River, 1984.

	Salmon	Grilse	Rod days
New Brunswick			
Angling camps	-	859	5,394
Crown open and reserve	-	519	1,354
Quebec	590	612	6,915
TOTAL	590	1,990	13,663

Table 5. Preliminary 1984 landings in Restigouche River from the commercial, Native and recreational fisheries. The 1983 landings are updated from Randall and Pickard (1983).

Fishery	1984		1983	
	Salmon	Grilse	Salmon	Grilse
Commercial traps				
New Brunswick	889	5,819	1,773	1,319
Quebec	-	-	2,342	85
Native				
Cross Point	1,081	173	1,216	32
Eel River Bar	213	1	260[a]	-
Recreational	590	1,990	2,068	896
TOTAL	2,773	7,983	7,659	2,332

[a] Eel River Bar landings were not used in 1983 assessment.

Table 6. Commercial and recreational salmon landings from Baie des Chaleurs and Restigouche River, 1951 to 1984. Data are numbers x 10^3 (updated from Randall and Pickard 1983).

	COMMERCIAL							RECREATIONAL							
	New Brunswick			Québec				New Brunswick			Québec				
Year	Gr.	Sal.	Total	Gr.	Sal.	Total	TOTAL	Gr.	Sal.	Total	Gr.	Sal.	Total	TOTAL	GRAND TOTAL
1951		17.7	17.7		24.7	24.7	42.4			3.5	0.0	0.2	0.2	3.7	46.1
1952		19.2	19.2		20.4	20.4	39.6			5.7	0.1	0.4	0.5	6.2	45.8
1953		16.9	16.9		15.0	15.0	31.9			3.0	0.1	0.1	0.2	3.2	35.1
1954		17.1	17.1		14.2	14.2	31.3			2.9	0.1	0.4	0.5	3.4	34.7
1955		8.2	8.2		10.1	10.1	18.3			2.0	0.1	0.2	0.3	2.3	20.6
1956		7.5	7.5		7.7	7.7	15.2			2.3	0.1	0.2	0.3	2.6	17.8
1957		9.6	9.6		10.3	10.3	19.9			3.4	0.1	0.3	0.4	3.8	23.7
1958		15.4	15.4		11.4	11.4	26.8			9.1	0.2	0.4	0.6	9.7	36.5
1959		16.2	16.2		15.9	15.9	32.1			3.2	0.1	0.2	0.3	3.5	35.6
1960		13.5	13.5		17.1	17.1	30.6			3.0	0.0	0.0	0.0	3.0	33.6
1961		12.1	12.1		9.9	9.9	22.0			3.2	0.0	0.0	0.0	3.2	25.2
1962		16.4	16.4		11.0	11.0	27.4			3.4	0.0	0.0	0.0	3.4	30.8
1963		13.8	13.8		10.3	10.3	24.1			7.4	0.0	0.0	0.0	7.4	31.5
1964		15.9	15.9		12.9	12.9	28.8			6.5			0.4	6.9	35.7
1965		22.8	22.8		16.8	16.8	39.6	3.9	3.0	6.9			0.7	7.6	47.2
1966		17.8	17.8		15.5	15.5	33.3	1.7	1.7	3.4			0.7	4.1	37.4
1967		21.4	21.4		13.3	13.3	34.7	1.1	2.4	3.5			0.8	4.3	39.0
1968		15.7	15.7		11.0	11.0	26.7	0.4	0.6	1.0			0.2	1.2	27.9
1969		10.2	10.2		8.2	8.2	18.4	1.4	1.2	2.6			0.4	3.0	21.4
1970		9.1	9.1		9.1	9.1	18.2	1.4	1.7	3.1	0.2	0.3	0.5	3.6	21.8
1971		3.9	3.9		5.0	5.0	8.9	1.0	0.8	1.8	0.2	0.2	0.4	2.2	11.1
1972	0.1	0.0	0.1	0.0	0.0	0.0	0.1	1.0	3.8	4.8	0.1	1.2	1.3	6.1	6.2
1973	0.7	0.2	0.9	0.6	0.1	0.7	1.6	1.4	3.8	5.2	0.2	1.1	1.3	6.5	8.1
1974	0.0	0.0	0.0	0.1	0.1	0.2	0.2	1.0	4.8	5.8	0.1	1.2	1.3	7.1	7.3
1975	0.2	0.9	1.1	0.0	0.1	0.1	1.2	1.1	2.2	3.3	0.2	0.7	0.9	4.2	5.4
1976	3.7	0.1	3.8	1.4	0.1	1.5	5.3	2.3	4.5	6.8	0.4	1.0	1.4	8.2	13.5
1977	1.1	0.2	1.3	0.0	0.0	0.0	1.3	2.4	5.1	7.5	0.4	1.6	2.0	9.5	10.8
1978	1.5	0.2	1.7	0.0	0.0	0.0	1.7	1.3	3.4	4.7	0.3	1.6	1.9	6.6	8.3
1979	0.1	0.7	0.8	0.0	0.0	0.0	0.8	2.0	1.0	3.0	0.6	0.8	1.4	4.4	5.2
1980	2.0	0.0	2.0	0.0	0.0	0.0	2.0	2.8	4.1	6.9	0.4	2.1	2.5	9.4	11.4
1981	3.1	3.5	6.6	0.0	0.0	0.0	6.6	3.0	2.8	5.8	0.6	1.4	2.0	7.8	14.4
1982	2.1	2.6	4.7	0.1	1.9	2.0	6.7	2.5	1.6	4.1	0.4	1.0	1.4	5.5	12.2
1983	1.5	2.2	3.7	0.1	2.3	2.4	6.1	0.7	1.5	2.2	0.2	0.6	0.8	3.0	9.1
1984	7.2	2.0	9.2	0.0	0.0	0.0	9.2	1.4	0.0	1.4	0.6	0.6	1.2	2.6	11.8

Table 7. Counts of salmon and grilse at the fish barrier on the N.W. Upsalquitch River, 1980 to 1984.

Year	Grilse	Salmon	Total
1980	843	887	1,730
1981	789	481	1,270
1982	819	622	1,441
1983	430	301	731
1984	512	612	1,124

Table 8. Juvenile Atlantic salmon densities in the Restigouche River, 1972 to 1984. n = number of sites.

Year	n	Mean Density / 100 m^2		
		Fry	Small Parr	Large Parr
1972	22	4.99	2.00	1.07
1973	25	17.29	2.54	0.99
1974	26	12.57	7.12	<1.00
1975	31	31.25	9.66	2.67
1976	30	15.08	8.35	1.55
1977	34	18.99	4.36	1.60
1978	38	23.38	8.26	1.40
1979	40	10.73	7.13	2.07
1980	41	10.88	4.14	1.68
1981	44	17.27	3.57	<1.00
1982	46	8.83	4.36	<1.00
1983	50	33.52	6.87	3.45
1984	50	24.55	5.00	1.57

Table 9. Total returns of salmon to Restigouche River and catch of grilse at Kedgwick Lodge in the previous year (1969-84). Total returns are calculated in Table 10. Returns of salmon predicted for 1984 and 1985 are given in parenthesis.

Year (i)	Kedgwick Lodge grilse catch (year i)	Total returns of salmon to Restigouche (year i +1)
1969	174	21,600
1970	124	10,600
1971	72	8,600
1972	36	8,700
1973	30	10,400
1974	27	6,500
1975	33	11,600
1976	71	14,700
1977	37	9,300
1978	25	5,600
1979	128	14,300
1980	26	11,200
1981	45	11,200
1982	69	9,600
1983	44	(9,700)
1984	83	(12,200)

Table 10. Returns of large salmon (numbers x10^3) to the Restigouche River, 1970 to 1984. Escapement (1970 to 1983) was estimated as total angling X 0.72 (see text). Escapement in 1984 was calculated from a hypothetical total angling harvest of 3,300 salmon [(3,300 X 0.72) + (3,300-590)].

Year	Angling		Commercial		Native	Disease	Escapement	Total
	NB	PQ	NB	PQ				
1970	1.7	0.3	9.1	9.1	-	-	1.4	21.6
1971	0.8	0.2	3.9	5.0	-	-	0.7	10.6
1972	3.8	1.2	0.0	0.0	-	-	3.6	8.6
1973	3.8	1.1	0.2	0.1	-	-	3.5	8.7
1974	4.8	1.2	0.0	0.1	-	-	4.3	10.4
1975	2.2	0.7	0.9	0.1	-	0.5	2.1	6.5
1976	4.5	1.0	0.1	0.1	1.6	0.3	4.0	11.6
1977	5.1	1.6	0.2	0.0	2.7	0.3	4.8	14.7
1978	3.4	1.6	0.2	0.0	-	0.5	3.6	9.3
1979	1.0	0.8	0.7	0.0	0.8	1.0	1.3	5.6
1980	4.1	2.1	0.0	0.0	1.6	2.0	4.5	14.3
1981	2.8	1.4	3.5	0.0	-	0.5	3.0	11.2
1982	1.6	1.0	2.6	1.9	1.7	0.5	1.9	11.2
1983	1.5	0.6	2.2	2.3	1.2	0.3	1.5	9.6
1984	0.0	0.6	2.0	0.0	1.1	0.2	5.1	9.0

Table 11. Potential and actual egg deposition in the Restigouche River, 1972 to 1982. Potential and actual depositions were calculated using Methods 1 and 2, respectively (see text).

Year	Egg deposition (X10^6)		Percent eggs lost
	Potential	Actual	
1972	114.1	21.1	82
1973	122.8	28.9	76
1974	144.1	25.0	83
1975	76.2	13.1	83
1976	142.0	24.7	83
1977	146.1	21.1	86
1978	122.5	12.2	90
1979	44.9	10.7	76
1980	115.8	13.1	89
1981	100.6	20.5	80
1982	61.3	14.9	76
Mean			82.18
S.D.			4.94

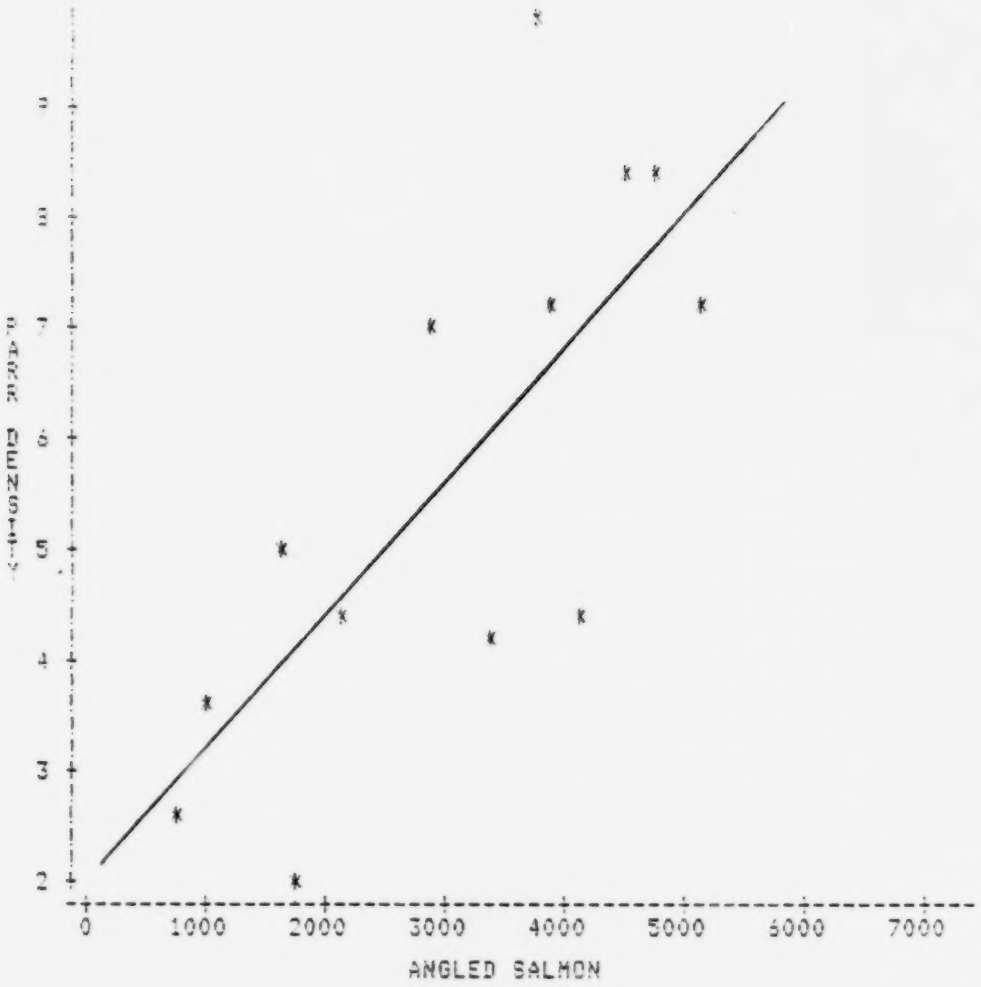

Fig. 1. Stock-recruitment relationship for Atlantic salmon in the Restigouche River. Angled salmon (year i) were used as an index of spawning stock, and age 1+ parr (year i +2; number per 100 m^2) as an index of recruitment.